

2013 Demersal Shelf Rockfish Remotely Operated Vehicle Survey

by

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October 2013

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Mathematics, statistics			
centimeter	cm	Alaska Administrative Code	AAC	all standard mathematical signs, symbols and abbreviations			
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H _A		
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	<i>e</i>		
hectare	ha			catch per unit effort	CPUE		
kilogram	kg			coefficient of variation	CV		
kilometer	km	at	@	common test statistics	(F, t, χ^2 , etc.)		
liter	L			confidence interval	CI		
meter	m			compass directions:	correlation coefficient		
milliliter	mL	east	E	(multiple)	R		
millimeter	mm	north	N	correlation coefficient			
Weights and measures (English)		south	S	(simple)	r		
	cubic feet per second	ft ³ /s	west	W	covariance	cov	
	foot	ft	copyright	©	degree (angular)	°	
	gallon	gal	corporate suffixes:		degrees of freedom	df	
	inch	in	Company	Co.	expected value	<i>E</i>	
	mile	mi	Corporation	Corp.	greater than	>	
	nautical mile	nmi	Incorporated	Inc.	greater than or equal to	≥	
	ounce	oz	Limited	Ltd.	harvest per unit effort	HPUE	
	pound	lb	District of Columbia	D.C.	less than	<	
	quart	qt	et alii (and others)	et al.	less than or equal to	≤	
	yard	yd	et cetera (and so forth)	etc.	logarithm (natural)	ln	
	Time and temperature		exempli gratia		logarithm (base 10)	log	
		day	d	(for example)	e.g.	logarithm (specify base)	log ₂ , etc.
		degrees Celsius	°C	Federal Information Code	FIC	minute (angular)	'
		degrees Fahrenheit	°F	id est (that is)	i.e.	not significant	NS
degrees kelvin		K	latitude or longitude	lat. or long.	null hypothesis	H ₀	
hour		h	monetary symbols		percent	%	
minute		min	(U.S.)	\$, ¢	probability	P	
second		s	months (tables and figures): first three		probability of a type I error		
Physics and chemistry			letters	Jan,...,Dec	(rejection of the null hypothesis when true)	α	
		all atomic symbols		registered trademark	®	probability of a type II error	
		alternating current	AC	trademark	™	(acceptance of the null hypothesis when false)	β
		ampere	A	United States		second (angular)	"
		calorie	cal	(adjective)	U.S.	standard deviation	SD
		direct current	DC	United States of America (noun)	USA	standard error	SE
		hertz	Hz	U.S.C.	United States Code	variance	
	horsepower	hp			population	Var	
	hydrogen ion activity (negative log of)	pH			sample	var	
	parts per million	ppm	U.S. state	use two-letter abbreviations			
	parts per thousand	ppt, ‰		(e.g., AK, WA)			
	volts	V					
	watts	W					

REGIONAL OPERATIONAL PLAN CF.1J.2013.09

**2013 DEMERSAL SHELF ROCKFISH REMOTELY OPERATED
VEHICLE SURVEY**

by

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Division of Commercial Fisheries

October 2013

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SIGNATURE PAGE

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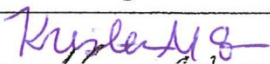
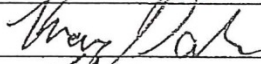
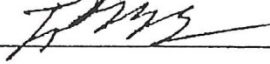
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PURPOSE

The federal Fishery Management Plan for Groundfish of the Gulf of Alaska delegates management authority for Demersal shelf rockfish (DSR) in the Southeast Outside Subdistrict (SEO) of the Eastern Gulf of Alaska to the Alaska Department of Fish and Game (ADF&G). The purpose of this survey is to assess yelloweye rockfish population status in SEO using a remote operated vehicle (ROV). As funding allows, a different management area will be selected to survey each year. In 2013, the Southern Southeast Outside (SSEO) management area will be surveyed to collect data on yelloweye rockfish density and size composition to calculate a biomass estimate. Biomass estimates obtained for a management area will be used to update the Stock Assessment and Fishery Evaluation (SAFE) report and the SEO-wide biomass estimate, acceptable biological catch (ABC), and total allowable catch (TAC) and will be reviewed by the North Pacific Fishery Management Council (Council). The Council-approved TAC will be used to set the guideline harvest levels (GHL) for the commercial and recreational DSR fisheries in SEO. In addition to the survey data, commercial fishery catch per unit effort (CPUE), and age, length, weight, and maturity information will be considered in management decisions.

BACKGROUND

The DSR assemblage (comprised of canary, China, copper, quillback, rosethorn, tiger, and yelloweye rockfish) is a commercially important suite of rockfish species caught in commercial longline, recreational, and subsistence fisheries in Southeast Alaska. DSR are highly susceptible to over-exploitation due to their life history traits (slow growing, long lived, and late maturing); thus, careful management is necessary for this species complex.

The federal Fishery Management Plan for Groundfish of the Gulf of Alaska delegates management of DSR to the State of Alaska. ADF&G began conducting a fishery-independent, habitat-based stock assessment for DSR using visual survey techniques (i.e. a submersible) to record DSR observations on line transects in rock habitat in 1988. In 1992, SEO was expanded from outside waters east of 137° W longitude to outside waters east of 140° W longitude. Currently, SEO includes the following management areas: East Yakutat (EYKT), Northern Southeast Outside (NSEO), Central Southeast Outside (CSEO), and Southern Southeast Outside (SSEO) (Figure 1). The DSR stock assessment surveys have historically rotated among management areas on a biannual basis; it would be time and cost-prohibitive to survey the entire SEO in one field season due to the large size of the area. Instead, the most recent abundance estimate from a management area is used to update the annual stock assessment for SEO, but four to six years may elapse between surveys (Brylinsky et al. 2009). Prior to 2010 ADF&G assessed DSR biomass based on observations from a manned submersible. Between 1988 and 2010, density estimates derived from yelloweye rockfish counts from submersible video observations were extrapolated over the total yelloweye rockfish habitat. Average weight for yelloweye rockfish landed in the halibut and directed commercial fisheries was applied to the density estimate to obtain a biomass estimate for each management area (O'Connell and Carlile 1993, Brylinsky et al. 2009). A 2% harvest rate was applied to the lower 90% confidence interval for the biomass estimate in each management area to determine the overall ABC for yelloweye rockfish. The yelloweye rockfish biomass estimate was increased by 4% to account for the other species in the DSR complex (yelloweye rockfish typically compose >96% of the total DSR harvest). The DSR biomass estimate for the SEO subdistrict is published in the annual Gulf of Alaska SAFE report (e.g. Brylinsky et al. 2009, Green et al. 2012) and forms the basis for the Council's TAC recommendation.

In 2012, ADF&G transitioned to using an ROV given the unavailability of an appropriate submersible. Although the survey vehicle changed, the basic process to perform the stock assessment for the DSR complex remains unchanged. ROVs are low cost and versatile tools that have been increasingly used to study marine habitats and organisms (e.g. Pacunski et al. 2008). In 2012, we utilized the expertise of ADF&G staff in the Central Region to conduct the pilot study in accordance with their established methodology for ROV surveys. In Central Region, ROV surveys have been successfully conducted for nearshore rockfish and lingcod populations since 2002.

The goal of the pilot study was to determine if accurate density estimates could be obtained using a ROV in lieu of a submersible, and if the assumptions of distance sampling could be satisfied (Buckland et al. 1993) using an alternative and unmanned underwater vehicle. The assumptions of the pilot study were not violated and resulting yelloweye rockfish density estimates had a coefficient of variation (CV) of 13%. Ralston et al. (2011) examined stock assessments for 17 data-rich groundfish and coastal pelagic species, and found the mean CV for terminal biomass estimate to be 18%. In this context, a CV of 13% was considered a high level of precision, a view supported by Robson and Regier (1964) and Seber (1982). Although we were not able to compare the ROV results directly with the submersible or account for natural changes in the yelloweye rockfish population between years, the ROV yelloweye rockfish density estimate for 2012 was comparable to previous submersible estimates with a similar magnitude (Figure 2). The ROV was successfully deployed in most weather conditions and able to navigate the seafloor and currents in the preferred direction and orientation for the majority of the planned dive transects. Forty-six of the 60 planned transects were completed during the ten day survey in August 2012. We could not complete the remaining transects due to a combination of high seas, wind, and strong currents. Although the ROV was deployed in seas up to 4–6' and wind speeds of 15–20 knots, it had a lower minimum operating threshold than the submersible, in part because we were operating from a 60' vessel in 2012 that was unable to provide as much protection from wind for ROV deployment compared to the 101' vessel used in previous years. The ROV is remotely operated, has a tether, and is lighter than the submersible; therefore, its operation is more easily hindered by strong underwater currents. We also lost a day and a half of survey time due to technological difficulties with the tether, which has since been replaced. The video quality of the stereo cameras used during the pilot study were sufficient to identify and measure yelloweye rockfish; however, some of the more cryptic species were difficult to identify due to image quality. In 2013, the ROV has been upgraded with high definition (HD) machine-vision stereo video cameras. Overall, the pilot study indicated that the ROV was a realistic vehicle for assessing yelloweye rockfish stocks in SEO. We will continue to evaluate the ROV's potential as a stock assessment tool in 2013 through the following objectives:

OBJECTIVES

1. Obtain a density estimate with a coefficient of variation (CV) <15% for yelloweye rockfish in the rocky habitat in the SSEO management area using distance sampling techniques. Other ROV and submarine surveys typically show CV levels between 15% and 30% when estimating species density (Yoklavish et al. 2007, Pacunski et al. 2008). We select a conservative target uncertainty given the long-lived nature of yelloweye and the associated susceptibility to over-harvesting even when catch levels remain constant;

2. Obtain total length measurements for yelloweye rockfish observed from line transects in the SSEO management area.

SECONDARY OBJECTIVES

1. Identify, enumerate and collect a 3D-point measurement with a precision level recommended by the authors of the implemented measurement software for other non-yelloweye rockfish DSR species, halibut, and lingcod (Seager (2012) recommends a root mean square (RMS) error <10 mm);
2. Obtain length measurements for lingcod and halibut at the best orientation and position possible in relationship to the video cameras and with RMS error <10 mm for each endpoint of the length measurement;
3. Review video to classify bottom substrate.

METHODS

SAMPLE DESIGN

The 2013 ROV survey will be conducted using distance sampling methodology to estimate yelloweye rockfish density in the SSEO management area. Random dive locations for line transects (Figure 3) will be selected in yelloweye rockfish habitat using ArcGIS. The preferred yelloweye rockfish habitat (rock habitat inshore of the 100-fathom line) was delineated from sidescan and multibeam sonar data and from the directed commercial fishery logbook data (catch per unit effort of ≥ 0.04 yelloweye rockfish per hook is considered a proxy for rocky habitat in the absence of sonar data) (O’Connell and Carlile 1993, Brylinsky et al. 2009). The total estimated area of rock habitat in SSEO is 1,056 km². Random locations were selected for each dive with a minimum distance of 2 km between each random point using the spatial ecology tool extension for ArcGIS. The 2 km distance was selected to avoid overlap among transects and after considering logistics of vessel running time between points. Transects of 1-km length were mapped at each random point with four possible orientations along the cardinal directions and crossing through the random point (Figure 4). The transect length of 1-km was selected after consideration of visual surveys conducted by other agencies, the encounter rate of yelloweye rockfish based on our previous surveys, and ROV pilot fatigue— at much longer transect lengths it becomes more difficult to maintain concentration. The random point was considered the midpoint for each transect; however, in cases where a transect extended outside the delineation of rocky habitat; the transect was shifted through the midpoint until it was within the rocky habitat delineation (Figure 3).

Buckland et al. (1993) recommends selecting a total transect line length sufficient to obtain 60–80 samples (individual fish observations) by

$$L_{target} = \left(\frac{b}{\{cv_t(\hat{D})\}^2} \right) \left(\frac{L_0}{n_0} \right) \quad (1)$$

for which L_{target} = the target total transect length, cv_t = the target coefficient of variation of the density estimate \hat{D} , L_0 and n_0 = the line-length and observed animal numbers from a pilot study, respectively, and b = a dispersion parameter (Buckland et al. 1993, page 242, eq. 7.1).

For small-scale pilot surveys the dispersion parameter is difficult to estimate and a value between 2 and 4 is typically chosen. However, because we performed an extensive pilot study in 2012 (i.e. large number of transects performed, high number of yelloweye rockfish observed, and good spatial coverage) we were able to estimate b using the number of yelloweye rockfish observed (n) and the CV of the 2012 density estimate ($cv(\hat{D})$) as

$$\hat{b} \cong n \cdot \{cv(\hat{D})\}^2 \quad (2)$$

(Buckland et al. 1993, page 243). Substituting eq (2) for b into eq (1) resolves to

$$L_{target} = \frac{L\{cv(\hat{D})\}^2}{\{cv_t(\hat{D})\}^2} \quad (3)$$

Using the 2012 ROV line transect study for L and cv values produces a target total line transect length for 2013 of 60 kilometers.

To obtain a total transect length of 60 km, 60 1-km transects will be performed on the 2013 ROV survey. In the event that weather or logistics prevent us from reaching our target number of transects, we will still be able to obtain good precision and a large enough sample size to obtain valid density estimates if >30 transects are performed. For example, if 37 1-km transects are completed then >80 yelloweye rockfish should be observed which would allow us to estimate a density with the same uncertainty as the 2012 survey (i.e. a CV of 13%).

The 2013 transect plan lines will be loaded into the Hypack^{®1} (navigational software) program for navigating transects and data acquisition. The following navigation data will be recorded to determine ROV position: ROV x, y, z position calculated from an ultra-short-base-line (USBL) tracking system; vessel GPS position; vessel pitch and roll to adjust for positioning errors due to vessel motion; ROV heading; and a continuous video record from four cameras

DATA COLLECTION

A Deep Ocean Engineering, Phantom HD2+2 ROV (property of ADF&G Division of Commercial Fisheries in Homer, AK) will be used as the survey vehicle. The ROV has four horizontal, one lateral, and one vertical thruster. There are two 250-watt halogen lamps to illuminate the viewing area. A GPS time code generator will be used to co-register video frames among multiple cameras and with acoustic tracking data.

A pair of stereo cameras will be used to record video data from line transects. The stereo camera data will be analyzed using SeaGIS software (SeaGIS Pty Ltd., EventMeasure version 3.50). The SeaGIS software is a measurement science software used to log and archive events occurring in digital imagery. Two additional cameras will be mounted to the ROV, the “main” camera, which is a wide-angle, color camera that the pilot will use to drive the ROV and a “forward-facing” camera. Two scaling lasers, mounted 10 cm apart and in line with the camera housing, will be used as measurement reference for objects viewed in the non-stereo cameras, and measurement of objects viewed in the stereo cameras will be recorded using SeaGIS software.

¹ Product names within this document are included for completeness and do not constitute product endorsement.

Dive number, date, transect number, transect type, transect start and end times, and comments will be logged manually for each dive. (Appendix A). All devices that keep time must be synchronized to Alaska Standard Time (AKST). The ROV pilot will maintain a speed of about 0.5 knots and remain approximately 1 m off the bottom, if possible. Two science crew will be in the ROV shed during each dive (pilot and navigator) and three crew will be on deck during a ROV dive. The ROV will be deployed into the water using the vessel crane, and then the clump weight (a 250 lb weight attached to the tether approximately 10 m away from the ROV that helps to keep the tether away from the vehicle) will be deployed after the ROV is in the water. One of the vessel crew will operate the winch for the clump weight, and two science or vessel crew will monitor the tether and clip the clump weight cable to the tether as the ROV descends.

DATA ANALYSIS

Transect Line Lengths

ROV position and transect line lengths will be estimated by editing tracking data generated from Hypack software. First tracking data will be filtered for outliers using Hypack® singlebeam editor. Sections of transects with large positioning errors will be deleted and linear interpolation will be used to fill in between accurate navigation positions. In addition, the data will be interpolated to one-second intervals. On average, navigation data are output every two to three seconds; however, navigation data must be at one-second intervals to accurately match with video observations. Video from the main camera will be reviewed to determine which segments of video are of good quality and when the ROV was moving forward. Each video segment will be given a video quality code and segment number (Appendices B and C). Coded video data will be interpolated to one-second intervals using MS Excel. Interpolated video quality data are used to select only the “Good Going Forward” (GGF) segments (Appendix B) from the navigation data in order to estimate the length for each transect. These GGF segments are smoothed in R statistical software using a smoothing spline. For transects where bad segments were clipped out, there may be more than one good navigation segment, so each segment is smoothed separately. Smoothed navigation data are visually examined for bad segments such as zigzags or loops. Video data are re-reviewed to determine if any problems occurred with the ROV during these segments and if they should be recoded and clipped from the segments used to estimate line length. If no problems can be identified in the video, then erroneous points are removed manually and the navigation data are resmoothed. Smoothed location data are mapped in ArcGIS, and the video quality segments are overlayed the smoothed location data using linear referencing. The total line length for each transect is estimated using the GGF segments only.

Video Review

Fish will be observed on the right and left side of the “center line” of the line transect when reviewing video within the SeaGIS Event Measure software (Figure 5). A digitized stereo left and stereo right camera video file will be loaded into the Event Measure software program and then the left and right videos will be synchronized according to the manual (Appendix D). The video reviewer will identify and enumerate yelloweye rockfish for density estimation, and other DSR, lingcod, halibut and other large-bodied fish, as time allows, for species composition. Fish total length will be recorded for individual yelloweye rockfish, lingcod, and halibut. Fish behavior (Appendix F) and maturity stage will be recorded for yelloweye rockfish only. Coloration and morphological characteristics will be used to identify maturity stage of yelloweye rockfish (Appendix G).

For each fish, a perpendicular distance from the origin of the transect line to the fish will be obtained through the SeaGIS software. The precision of a 3D point is a geometric function of the camera resolution, camera focal length, camera separation, camera distance from object (close is better precision) and object distance from center of field of view (center of field of view is more precise than at the edges). Fish will be marked in both the left and right stereo cameras to obtain a 3D point measurement with coordinates of x, y, and z; the perpendicular distance to the fish corresponds to “x” (Figure 6). The fish will be marked at the tip of the snout, if possible; otherwise the fish will be marked on a part of its body or tail that can be marked with precision in both the right and left stereo cameras. The SeaGIS software calculates a RMS, i.e. the positive square root of the variance for each 3D point measurement. The reviewer will attempt to obtain a RMS <10 mm for each measurement. When this is not possible (e.g. if the fish is in the corner of the viewing screen, or at a poor orientation to the cameras) the reviewer will note in the comments the reason for the poor RMS value. If fish are observed in only one stereo camera (i.e. not in the overlapping field between the two stereo cameras), then a 3D point measurement cannot be generated. For these fish, perpendicular distance will be estimated using the two laser beams in the field of view. Fish that swim into the field of view more than once will not be double counted (this behavior is obvious, and based on our observations, rare for yelloweye rockfish).

The video reviewer will make every effort to record yelloweye at first observation on the video to minimize any effect of fish movement in response to the ROV as the ROV moves closer to the animal. Yelloweye rockfish are usually observed in the distance (as great as 8 m) from the ROV, and the video reviewer will rewind the video to accurately record the *first* detection of the fish in the video using the Event Measure software. Other rockfish in the DSR complex will be recorded as early as possible, but accuracy at first detection is less critical; these fish will not be used in the distance analysis. Other species may be identified and recorded opportunistically; these fish should be utilized for species composition only and not to estimate population densities.

Fish total length will be recorded from the tip of the snout to the tip of the caudal fin. Length measurements are most accurate when fish are close, straight (i.e. not curled), and parallel, relative to the cameras; the video reviewer will measure each fish in the best possible orientation and position and will attempt to obtain RMS <10 mm for both endpoints of the length measurement. The best possible horizontal direction will be obtained; the horizontal direction is the angle between the horizontal component of the measured length and the camera base and represents the degree to which a fish is turned away from the camera. For example, if a fish is parallel to the camera then it has a horizontal direction of 0° and if a fish is facing directly toward or away from the camera, the horizontal direction is 90°. As the horizontal direction increases, the precision of a length measurement decreases because the Δz (the difference in the z coordinate between the snout and tail) becomes larger ($\Delta z=0$ when fish parallel) as

$$\sigma_d = \frac{1}{d} \sqrt{2(\Delta x^2 \sigma_x^2 + \Delta y^2 \sigma_y^2 + \Delta z^2 \sigma_z^2)} \quad (4)$$

for which σ_d = the standard deviation of a given length measurement (Seager, 2012) Precision is expressed in terms of the difference between the x, y, and z coordinates for each endpoint of the length measurement (Δx , Δy , Δz), the standard deviation (precision) of x, y, and z (σ_x , σ_y , σ_z), and

the length of the fish (d). The standard deviation of x and y is equivalent and small compared to the standard deviation of z . When a fish is parallel $\Delta z = 0$ and there is no contribution to the error from Δz , but as a fish turns away from the camera, Δz increases resulting in a decrease in precision (σ_d). We will attempt to obtain a horizontal direction $<30^\circ$ for each fish. The horizontal direction may be used to filter out less accurate length measurements. Fish that are not straight will not be measured. If a fish cannot be measured for any reason (i.e. a fish is under a rock, or in a crack) we will note that no length measurement was taken and explain why the measurement was not taken in the comments.

Density and Biomass Estimates

Yelloweye rockfish density will be estimated using DISTANCE 6.0 software (Thomas et al. 2006) which utilizes the following equations to estimate density with the principal function to estimate the probability of detection evaluated at the origin of the transect line ($\hat{f}(0)$):

$$\hat{D} = \frac{n\hat{f}(0)}{2L} \quad (5)$$

$$\hat{f}(0) = \frac{1}{\mu} = \frac{1}{wP_a} \quad (6)$$

where:

n = total number yelloweye rockfish adults and subadults >350 mm observed

$\hat{f}(0)$ = the probability density function evaluated at the origin of the transect line

L = total line length

μ = the effective width

w = width of line transect

P_a = probability of observing an object in the defined area

Subadult yelloweye rockfish > 350 mm total length will be included in the density estimate. The minimum size is based on the smallest yelloweye rockfish captured in the directed commercial fishery from 2007 to 2012. The best probability detection model will be selected in order to obtain a valid density estimate. Models will be explored with and without binning and truncation (i.e. at some predefined maximum distance) of distance data (Figure 7) and with different key model functions and adjustment terms. The best model will be selected based on visual fit of model, the Akaike information criterion (AIC) value, X^2 goodness of fit test, and the CV for the density estimate ($cv_t(\hat{D})$). Probability detection functions will be visually examined to determine if the model fits the data well; it is most important to have a good fit at the origin (Figure 7). In addition, the model will be examined to determine if the shape is biologically realistic, and if the model has the preferred “shoulder” at the origin of the transect line (Burnham et al. 1980).

Total yelloweye rockfish biomass will be estimated as the product of density, weight, and area of rocky habitat (O’Connell and Carlile 1993). In the past, the average weight of yelloweye rockfish sampled from the directed commercial fishery and from the halibut fishery has been used to

expand density estimates to biomass for each management area. With the addition of the stereo cameras, fish can be measured using the SeaGIS software. We plan to explore the conversion of yelloweye rockfish lengths collected from the video observations to weight using length-weight relationships for yelloweye rockfish. We will determine if these weights derived from these length-weight relationships are appropriate for estimating biomass while considering the sample size of the length data obtained from the ROV.

Evaluation of Distance Sampling Assumptions

Distance sampling (Buckland et al. 1993) requires that three major assumptions are met to achieve reliable estimates of density from line transect sampling: (1) objects on the line must be detected with certainty (i.e. every object on the line must be detected); (2) objects must be detected at their initial location, (i.e. animals do not move toward or away from the transect line in response to the observer before distances are measured); (3) distances from the transect line to each object are measured accurately. Failure to satisfy these assumptions may result in biased density estimates. All assumptions were carefully evaluated and met during the 2012 ROV survey.

In 2013 we will follow the same procedure as in 2012 to evaluate the distance sampling assumptions. To ensure that (1) all objects on the transect line are detected with certainty, we will examine the probability detection function and histograms of the distance data. If the detectability at the transect line is close to 100%, then the probability detection function will have a broad shoulder at the line that will drop off at some distance from the line (Figure 7) (Buckland et al. 1993). In the past submersible surveys, the observer looked out the side window to identify fish and fish close in proximity to the submersible were sometimes missed by the observer and the main camera. A “forward-facing” camera was installed to record fish directly on the transect line. However, the ROV cameras are already oriented forward, and the video reviewer should easily detect fish on the transect line.

The second assumption (2) that yelloweye rockfish are detected at their initial location and are not moving in response to the ROV prior to detection in the video will be evaluated by examining the probability detection function and the behavioral response of yelloweye rockfish to the ROV. The shape of the probability detection function may indicate if there is yelloweye rockfish movement response to the ROV. If the probability detection function has a high peak near the origin line, this may indicate an attraction to the ROV. Whereas, if there are lower detections near the line and an increase in detection at some distance away from the origin of the line this may indicate avoidance behavior. The 2012 pilot study results indicate that yelloweye rockfish are not moving in response to the ROV; generally yelloweye rockfish moved very little or slowly (85%), with the majority (76%) not indicating any directional movement (i.e. milling, resting on the bottom). These results are consistent with those observed in other ROV and submersible surveys and indicate that yelloweye rockfish move slowly relative to the speed of the survey vehicle. If undetected movements are random and slow relative to the speed of the ROV then this assumption will not be violated (Buckland et al. 1993). Byerly et al. (2005) found that yelloweye rockfish movement prior to detection by the ROV cameras was random.

The third assumption of distance sampling: (3) distances from the transect line to the fish are recorded accurately is met through the use of the SeaGIS software. The SeaGIS EventMeasure software in conjunction with the stereo camera videos allows us to obtain a precise and accurate measurement of distance to the fish (Seager 2012). In the submersible surveys, the observer

estimated the perpendicular distance from the submersible to a fish by eye, which is subject to measurement error despite observer calibration before a dive using a hand-held sonar gun.

HABITAT REVIEW

Habitat video review will be conducted to classify bottom substrate. Habitat review protocols are currently being determined, and a habitat review manual will be created for future surveys. This review will be performed independently from the fish video review as time allows. Delinquent fishing gear will be recorded during the habitat review.

SCHEDULE AND DELIVERABLES

The 2013 survey will commence on the *R/V Pandalus* on August 15 and end on August 28, 2013 from Sitka, Alaska. A crew transfer in Craig, Alaska, is scheduled for August 22. Josh Mumm, Mike Byerly and Kristen Green will be at-sea for the duration of the survey. Jennifer Stahl will be on Leg 1, and Kray Van Kirk will be on Leg 2 of the survey.

Video review analysis will commence immediately after the survey.

The 2013 data will be used to update the stock assessment for yelloweye rockfish that will eventually be submitted to the Gulf of Alaska Plan Team for approval.

RESPONSIBILITIES

- Kristen Green, Fishery Biologist III (Project Leader)
- Jennifer Stahl, Fishery Biologist II (Data analyses, GIS support)
- Mike Byerly, Fishery Biologist II (ROV Pilot, technical support)
- Josh Mumm, GIS Analyst II (ROV Navigator, technical support)
- Kray Van Kirk, Biometrician III (Biometrics oversight)

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FIGURES

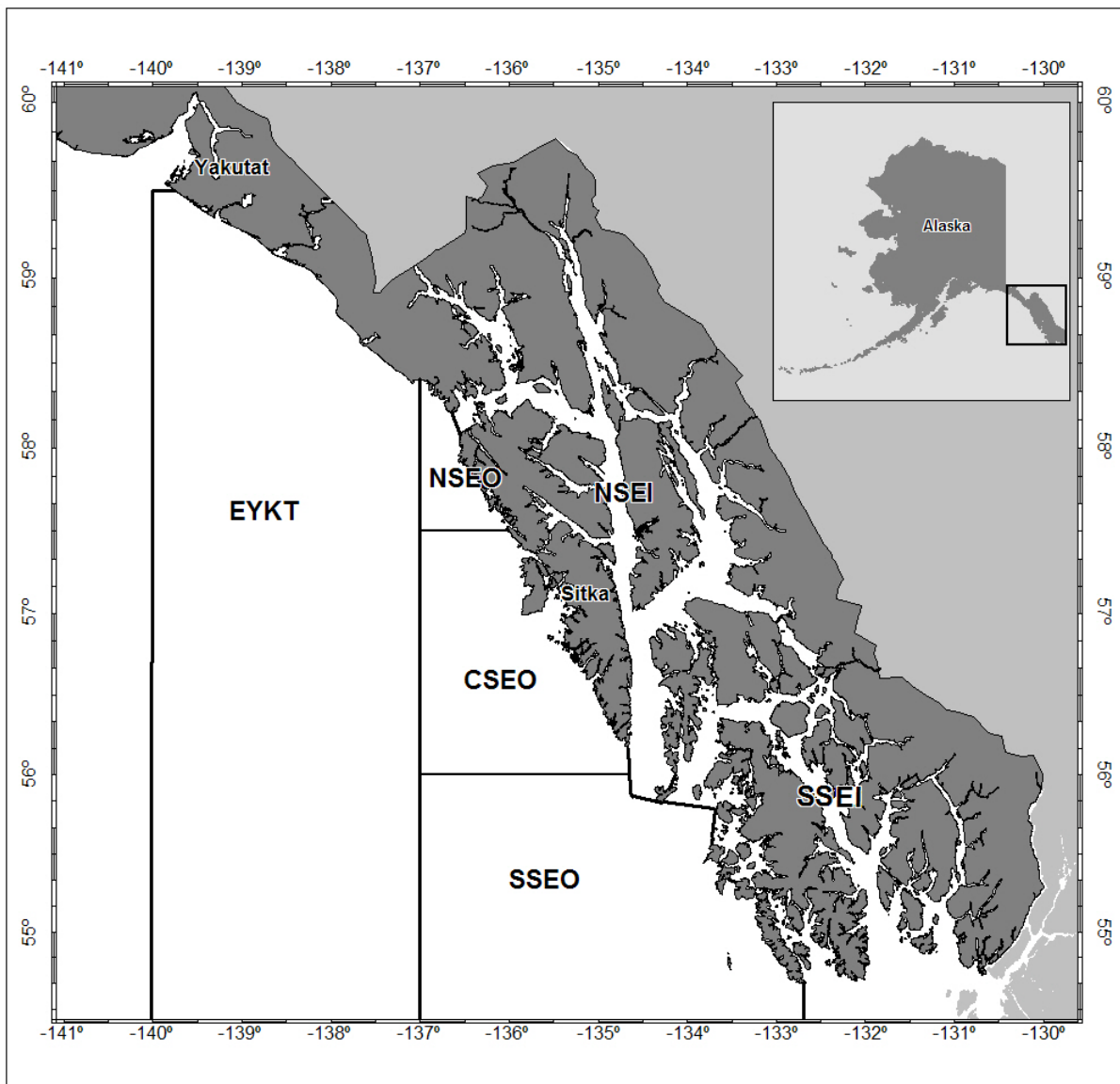


Figure 1.—Southeast Outside Subdistrict groundfish management areas in Southeast Alaska, including EYKT, NSEO, CSEO, and SSEI. In 2013 the Southern Southeast Outside management area will be surveyed.

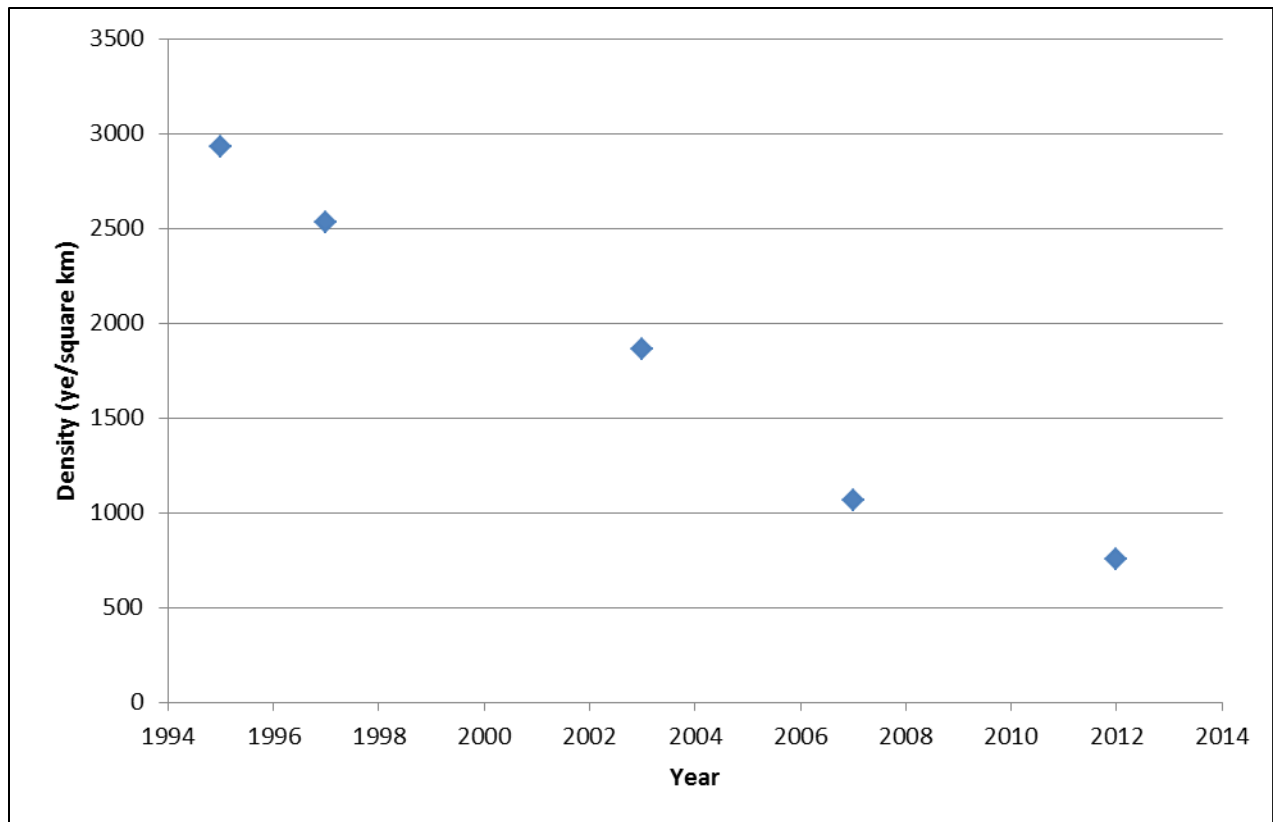


Figure 2.—Density of yelloweye rockfish (ye/square km) estimated from the submersible (1995, 1997, 2003, and 2007) and ROV (2012) surveys.

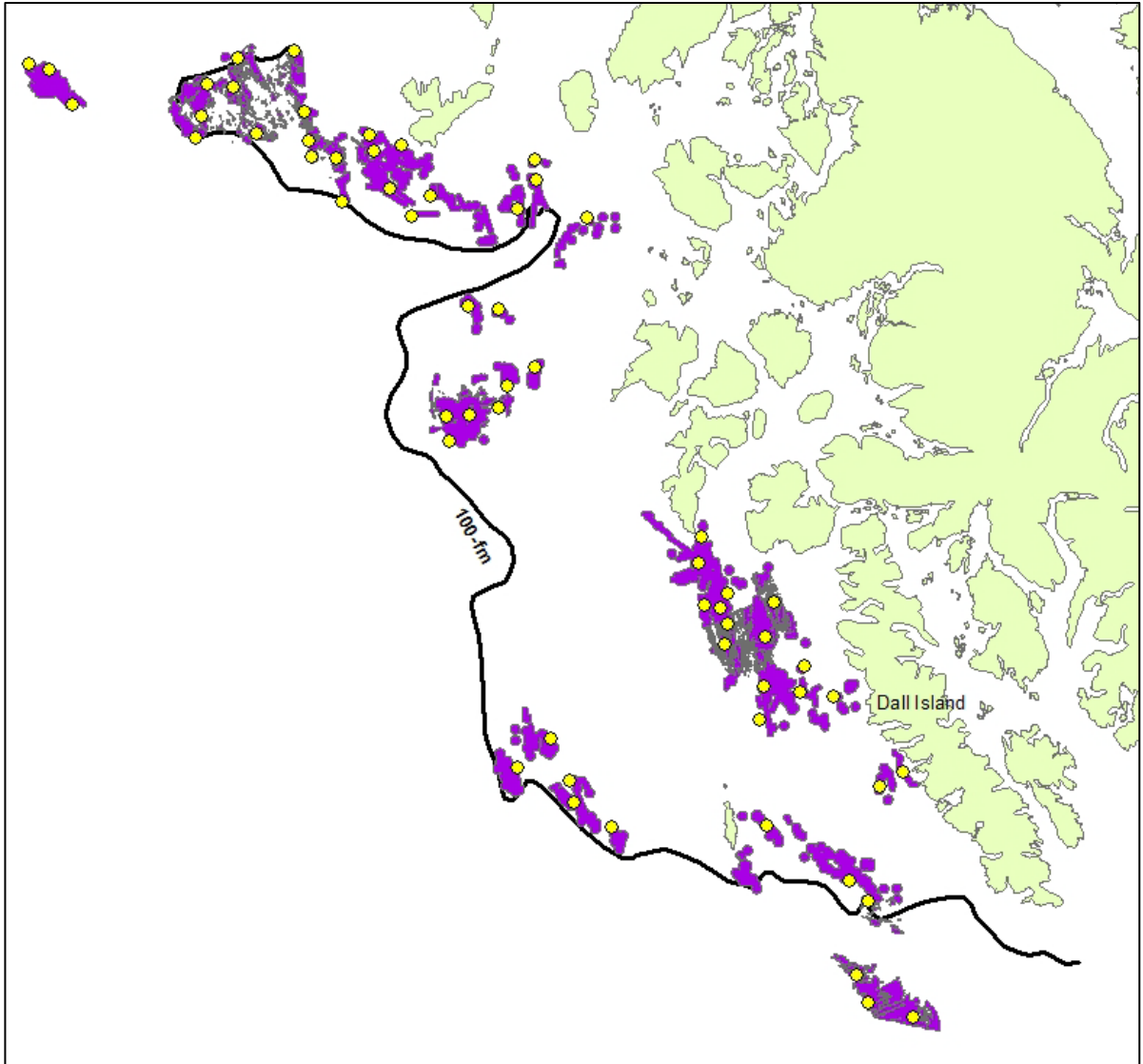


Figure 3.—SSEO management area map with 2013 dive transect locations.



Figure 4.—Example of 1-km transect plan lines for the 2013 ROV dives. Plan lines have been adjusted in some cases to remain within the delineation of rocky habitat (purple polygons).



Figure 5.—Yelloweye rockfish with a 3D point (red circle with black outline) and a total length (red line) measured in the stereo camera overlapping field of view in the SeaGIS Event Measure software.

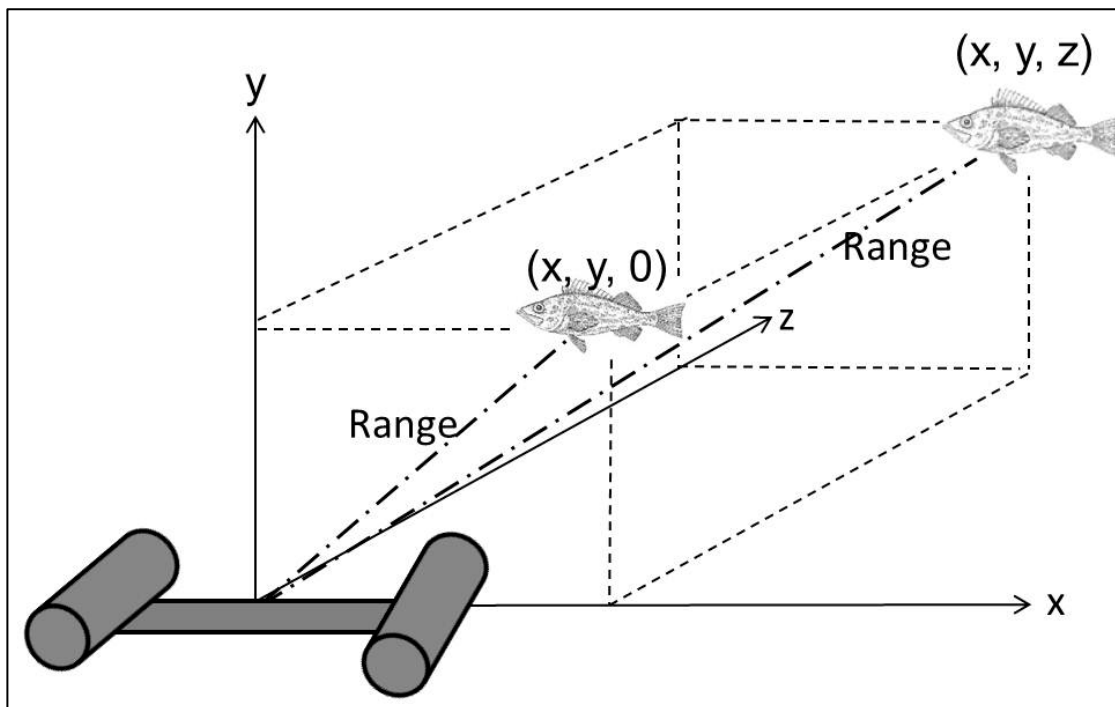


Figure 6.—The components of a 3D point measurement.

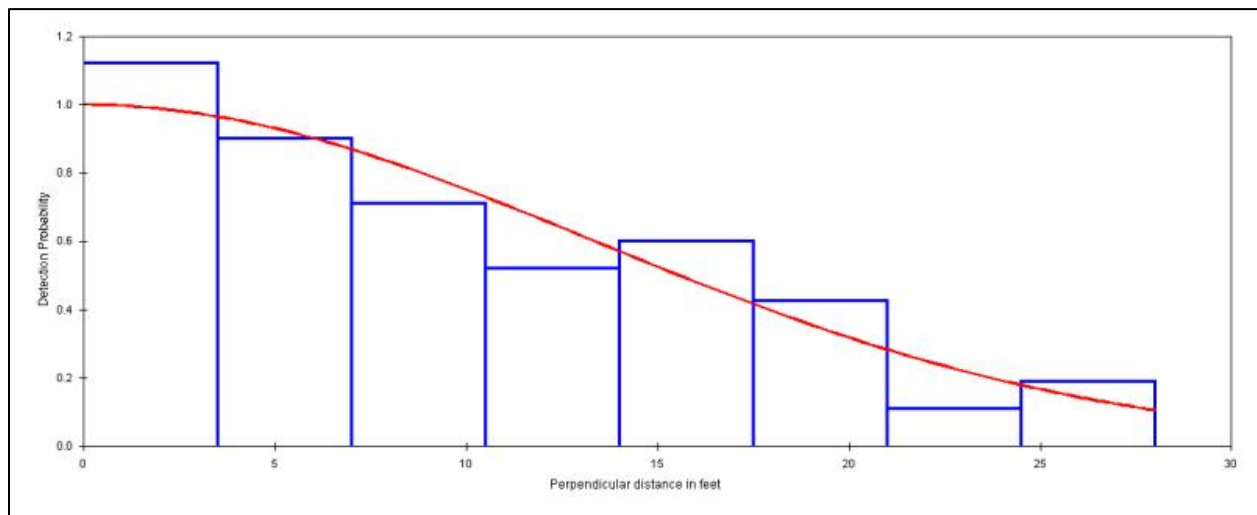


Figure 7.—Probability detection function with a half normal cosine model with 3.5-ft bins and truncation after 28 ft. This example probability detection function has good “shoulder” at the origin, and no peaks away from the origin that would indicate avoidance behavior in response to the observer.

APPENDICES

Dive Log: 2013 DSR Survey, Trip 1, August 15–August 28, R/V Pandalus,
ROV Buttercup, Pilot Mike Byerly

Alaska Time

No.	Date	Dive	Trans.	TX Orientation	Transect Type	Start Time	End Time	Comments—be sure to note if recalibrated or video stopped
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Appendix B.–Video Quality Codes

GGF	good going forward
GRB	resting on bottom
GRBC	resting on bottom with close-up image
BDO	going over drop-off
BBS	bottom stir-up
BLB	lost bottom visual
BGB	going backwards
BRB	resting on bottom
BCF	bad camera focus
BLA	loitering in same area
BPV	poor visibility
BRP	repositioned

Appendix C.–Video Quality Coding Instructions

1. Copy the SL camera .AVI file to C:\2013 DSR Survey\Quality Review
 2. Load EventMeasure , Click *Measurement | Open* C:\2013 DSR Survey\Quality Review\QC Template.EMObs
 3. Click *Measurement | Information Fields | Edit Field Values*
 4. Enter values in the bolded and (optional) comments fields; do not change the defaults
 - a. OpCode = QC (default)
 - b. Tape Reader = your name**
 - c. Depth = 0 (default)
 - d. Comment = (optional)
 - e. Year = 2013 (default)
 - f. Dive No. = 1 – 60 or dive numbers from last year**
 - g. Transect = transect number 1 for dives 1-60**
 - h. Dive Date (mm/dd/yyyy format)**
 - i. *Close dialog*
 5. Click *Picture | Set picture directory* navigate to C:\2013 DSR Survey\Quality Review
 6. Click *Picture | Load Picture*, click on the SL file , click *Open*
- Important: Check the Dive Log - if the video was stopped and restarted, skip Step 7 and see Step 9.f below.**
- Click *Picture | Define movie Sequence*
 - **Find the time stamp on the video**
 - **Type the time in the Sequence start time field where**
HH = hour (military time, leading zero for single digits, e.g. 08): MM = minutes: SS = seconds
 - a. Change Time format from Decimal minutes to HH:MM:SS.ss**
7. Click *Add file(s)*, click on the SL file, click *Open*, click *OK*
- Important: Look above the image and verify that frame = 0 and that time matches the time stamp on the video**
8. Click *Play Movie | Playback*
 - a. When Buttercup shakes her head, *Close player and update position*
 - b. Right click on the image and click *Add Point*
 - c. Click the **Species** drop-down and choose the appropriate quality code:

GGF	good going forward
GRB	resting on bottom
GRBC	resting on bottom with close-up image
BDO	going over drop-off
BBS	bottom stir-up
BLB	lost bottom visual
BGB	going backwards
BRB	resting on bottom
BCF	bad camera focus
BLA	loitering in same area
BPV	poor visibility
BRP	repositioned
 - d. Type **Start** in the Start/End field, Click OK
 - e. Type comments (optional)
 - f. If video was restarted, enter time stamp manually in the QC Event Time field in HH:MM:SS format**
 9. Click *Play movie | Playback* until a new quality condition occurs; add appropriate quality code
 10. Number the GGF segments consecutively, see example below
 11. If the last segment is GGF, then repeat the GGF code and segment number; note END in comments; see example
 12. Close EventMeasure; you will be prompted to save the file; name the file QC – ‘dive no.’ i.e. QC - 1.EMObs

Family	Genus	Species	Code	Number	Stage	Activity	Comment	Frame	Time (HMS)
Good	Good Going Forward	GGF	GGF	1	AD	Passing	START	975	06:43.5
Bad	Bad Camera Focus	BCF	BCF		AD	Passing		13155	06:48.9
Good	Good Going Forward	GGF	GGF	2	AD	Passing		13299	06:51.7
Bad	Going over drop-off	BDO	BDO		AD	Passing		25641	07:10.6
Good	Good Going Forward	GGF	GGF	3	AD	Passing		37998	07:12.9
Good	Good Going Forward	GGF	GGF	3	AD	Passing	END	57360	07:15.9

ADF&G EventMeasure—Loading Files

1. Copy the .AVI files for the left and right cameras to C:\2013 DSR Survey
You may need to delete the previous dive's camera files if the hard drive gets too full
2. Check the **Comments** column on the Dive Log to see if the cameras had been recalibrated for the dive
3. If recalibration occurred, copy the new left and right .CAM files to C:\2013DSR Survey
4. Load EventMeasure
5. Uncheck the **Lock Frame** box if it is checked, click *Toggle View* if you do not see the **Lock Frame** box
6. Click *Measurement* | click *Open*, click on the dive-transect number, click *Open*
7. Click *Picture* | *Set Picture Directory*, navigate to C:\2013 DSR Survey
8. Click *Picture* | *Load Picture*, click on the **Left** file , click *Open*
9. Click *Picture* | *Define movie Sequence*, click *Add file(s)*, click on the **Left** file, click *Open*, click *OK*
10. Click *Stereo* | *Cameras* | *Left* | *Load camera file*, go to C:\2013 DSR Survey, click on the **current Left.CAM** file, click *Open*
11. Click *Stereo* | *Cameras* | *Right* | *Load camera file*, go to C:\2013 DSR Survey, click on the **current Right.CAM** file, click *Open*
12. Click *Stereo* | *Picture* | *Load Picture*, click on the **Right** file , click *Open*
13. Click *Stereo* | *Picture* | *Define movie sequence*, click *Add file(s)*, click on the **Right** file, click *Open*, click *OK*

ADF&G EventMeasure—Species Enumeration and Measurement

1. Synchronize images, by matching the time and drop frame codes, then click the **Lock box**
2. Be sure that the **Data view** is **3D Points**
3. Click *Play movie* above the left image. It is suggested that the reviewer not review at a speed faster than “1.5” as fish may be missed at greater speeds.
4. Click *Playback*
5. Click *Close play and update position* when you see a fish that you want to enter
6. Click **once** on the **fish in the left and right images**; you will see the 3D point info box
7. Right click and click *Add 3D point*

IMPORTANT! Remember to check **OFTEN** that the frames match in each of the stereo cameras or you will have to go back and redo your measurements! If they do not match, you need to unlock and re-synchronize the frames, and then relock!

8. Click on the Species drop-down to select species code; Genus to select common name; or Family to select species group
9. **Stage** is maturity code; choose **AD** for adult; **SU** for subadult; or **JV** for juvenile, or **UK**, unknown.
10. **Activity**; choose the term that best describes the fish's behavior
11. **Check ID**, type **Y** to flag the record for checking the species identification
12. **Comment**; (optional) type a short comment
13. **IMPORTANT!** Remember to **HIGHLIGHT** the **row** you just entered to prepare for taking a measurement of the same fish

-continued-

14. Advance the video by frame until you get a broadside view of the fish and take a length measurement
15. Click on the **nose and tail of the fish** in the both the **right and left images** to take the measurement
16. You will see the Attributes – Length info. box, Click *OK*
17. When video review is complete, Click *Measurement/Measurement Summaries/3D point and length measurements*
18. Click *File/Save data to text file*, type the dive and transect number as the file name, Click *Save*
19. Close EventMeasure; you will be prompted to save the file
20. Send the file to Martina to load into the database

Appendix E.–Example Species Hierarchy and Codes. DSR codes only are shown in this table, actual species list is more extensive.

Region 1 Species Lookup Table for DSR Surveys

SPECIES_CLASS	COMMON_NAME	SPECIES_CODE
rockfish	canary	146
rockfish	China	149
rockfish	quillback	147
rockfish	rosethorn	150
rockfish	tiger	148
rockfish	yelloweye	145
Rockfish	copper	138

Appendix F.–Yelloweye rockfish behaviors.

1. Fish milling
2. Fish resting on bottom
3. Fish actively swimming in frame
4. Fish moving slowly into frame
5. Fish chasing other fish
6. Fish moving quickly into frame
7. Fish moving slowly out of frame
8. Fish seeking cover
9. Fish being chased

Appendix G.–Maturity Codes

1. AD = Adult
2. SU = Sub-adult
3. JV = Juvenile
4. YOY = young of the year

During the survey:

1. Go through dive checklist before each dive
2. Fill out Dive Log (Appendix A) while the dive is in progress
3. Enter Dive Log data into Dive Log spreadsheet
4. Perform video quality checks using
 - EventMeasure
 - Video Quality Check Codes (Appendix B)
 - Video Quality Check instructions (Appendix C)

After the survey:

1. Research Analyst – Prepares .EMObs files for Species Review
 - Makes a copy of .EMObs template file for each dive
 - Edits header information using Dive Log
2. Biologists – Perform Species Review
 - Use Left and Right camera video and calibration files
 - Follow EventMeasure Date Entry Instructions (Appendix D)
 - Use species codes (Appendix E)
 - Defined behaviors (Appendix F)
 - Maturity codes (Appendix G)
3. Research Analyst -
 - Process Quality Check data
 - Run batch text file report generation utility in EventMeasure, *Program | Batch text file output* See EventMeasure User Guide, pg. 16 for details
 - Run text file concatenation utility in EventMeasure, *Program | File concatenation utility* See EventMeasure User Guide, pg. 15 for details
 - Load concatenated .TXT file into Excel
 - Remove header rows, retain column headings
 - Change time format to 13:30:55 in Time(HMS) and QC Event Time columns
 - Change date format to 3/14/2001 in Dive date m/dd/yyyy field
 - Load quality check data into G_SUR_SUB_QUALITY_year
 - Load interpolated navigation data, provided by ROV pilot, into G_SUR_SUB_NAV_INTERP_year
 - be sure that there are no duplicate event/seconds rows
 - be sure that Quality file has <= seconds per event as NAV file
 - Run Quality Interpolation SQL in Navigation and Quality data workspace to get navigation data for GGF segments for biologist who derives line lengths
 - Load line lengths, provided by biologist, into LINE_LENGTH_METERS column in G_SUR_SUB_TRANSECT table
 - Run Start-End SQL, based on interpolated data, in Navigation and Quality data workspace to get start/end times for G_SUR_SUB_TRANSECT

-continued-

- Load Survey Header data, provided by ROV Pilot, into G_SUR_SUB_ROV_HEADER_year
- Load Transect data, from Dive Log spreadsheet, into G_SUR_SUB_TRANSECT
- Load Species Data
 - remove header row from SeaGIS output file = g_sur_sub_seagis_species_data.txt
 - be sure that stage and behavior are null for all species except yelloweye
 - control file for loading data into interim table = g_sur_sub_seagis_species.ctf
 - go to DOS command prompt
 - go to s:\programming\zander\g_sur_submersible
 - SQLLDR load/(password)@zdev control = g_sur_sub_seagis_species.ctf
 - check error log & verify no. of records in g_sur_sub_seagis_load
- Run SQL that merges GGF segments with species data
- Archive .AVI files
 - facilitate tape conversions to .MP4 files by Lucid Reverie
 - copy files to Pivot server and create pathing records in Video Online table
- Groundfish Staff performs habitat analysis